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1. Response to the needs of federal organizations by means of RADARSAT 2: 12 new applications projects supported by the Canadian Space Agency

The objectives of the Earth Observation Applications and Utilizations (EOAU) Division of the Canadian Space Agency (CSA) include optimizing the use of RADARSAT 2 data. Through its Earth Observation Applications Development Program (EOADP), the division has invited Canadian suppliers to submit proposals to improve, increase and optimize the use of the RADARSAT 2 data allocation. Innovative methods, systems, products or services derived from RADARSAT 2 data will be developed in response to the needs expressed by federal organizations. The EOADP is providing funding of nearly $6 million for this initiative, and Publics Works and Government Services Canada has awarded 12 contracts. Summaries of these new projects are presented in this special edition of the EO-Express. For more information, please contact Yann Denis, Manager, EOAU Programs (responsible for EOADP): yann.denis@asc-csa.gc.ca.

2. 3v Geomatics Inc.: Structural Health Monitoring of Public Infrastructure With RADARSAT-2

A significant component of Canada's infrastructure network was built between the 1950s and 1970s, and critical investment towards updating these structures has been deferred because of fiscal pressures. Ageing infrastructure means increased risk to Canadians. Through the CSA EOADP, 3v Geomatics (Vancouver, BC) will utilize RADARSAT-2 data and InSAR techniques to monitor displacement of Canadian bridges in Ottawa/Hull, Vancouver and Montreal. The main objectives of the project RADARSAT-2 Structural Health Monitoring (R2SHM) are: (1) Develop a non-destructive system for RADARSAT-2 Based Structural Health Monitoring of Public Infrastructure that will improve management of Canada's bridges and other infrastructure, based upon requirements from User Organizations; (2) Optimize advanced processing and application methodologies that will exploit RADARSAT-2's advanced imaging capabilities for monitoring bridge superstructures; (3) Develop Government of Canada institutional capacity for continuing future usage of RADARSAT-2 data. The project will be conducted in partnership with the CSA, the National Research Council's Institute for Research in Construction, Transport Canada's Transportation Development Centre and the Federal Bridge Corporation Limited.

OSMOS Canada Inc., a Montreal based firm specializing in monitoring engineering will support the project by providing in situ bridge monitoring data and interpretation. For more information, please contact Lyse.Champagne@asc-csa.gc.ca and jcm@3vgeomatics.com.

3. AECOM: Mapping products for paludification areas using RADARSAT-2

Understanding the causes and effects of paludification, as well as knowledge of its distribution in forests, is one of the priorities of Natural Resource Canada's Laurentian Forestry Centre of the Canadian Forest Service (CFS-LFC). Paludification is a natural phenomenon that occurs in the boreal forest, predominantly in the northern Abitibi and Ontario clay belt. The process involves the accumulation of organic matter in the soil and the invasion of sphagnums, which leads to the paludification of forest stands dominated by black spruce and the reduction of forest production. Forestry practices can either heighten or lessen the phenomenon, which, fortunately, is reversible. Local forestry stakeholders from Abitibi want to obtain digital maps of paludification in the area with a view to improving forest management to address paludification. As part of the EOADP, AECOM (Quebec City, Quebec) is developing a project titled "Improving forest mapping in boreal zones sensitive to paludification." The objectives of the project are to improve and regionalize the mapping of forest paludification using conventional multi-polarized data from RADARSAT-2 and PALSAR sensors combined with LANDSAT images, and to evaluate the potential of polarimetric data in terms of this application. The project is being developed in close collaboration with the CFS-LFC and the University of Quebec in Abitibi-Témiscamingue (UQAT). This partnership will help deliver to users operational mapping products for peat-affected forests (mapping of organic matter thickness and forest basal area), based on methods developed and tested by the CFS-LFC and the UQAT. Because biomass is strongly correlated with basal area, the project will also have an impact on the ability to map forest biomass in the boreal forest and could therefore contribute to certain needs of the National Forest Inventory and the CFS-LFC's Forest Carbon Accounting Program. For more information, send an email to Yann.Denis@asc-csa.gc.ca and paule.hebert@aecom.com.

4. Array Systems Computing Inc.: Open Source RADARSAT-2 Toolbox Software

World-class research is Canada's standard in science and technology. Canada's RADARSAT-2 satellite provides some of the highest resolution images available today. Licensing costs for commercial image processing and the lack of usability of existing analysis software may present barriers to better exploit the capabilities and scientific use of RADARSAT-2 data.. Through the CSA EOADP, Array Systems Computing (Toronto, ON) will develop an Open Source RADARSAT-2 toolbox that would increase and optimize the utilization of the RADARSAT-2 data allocation. Having the tools freely available to process, visualize and analyze RADARSAT-2 data would encourage government organization, industry and academia to maximize their utilization of RADARSAT-2 to produce more research and applications. As the primary government of Canada organization on the project, the Canadian Forest Service (CFS) will provide valuable input to requirements analysis and testing of the software to ensure it meets the needs of the CFS. In addition, the project will collaborate with the Geological Survey of Canada to enhance their RADARSAT-2 analysis capabilities. The software would be freely available to all Canadian Government Organizations, academia and industry to exploit RADARSAT-2 data. For more information, please contact Stéphane.Chalifoux@asc-csa.gc.ca and Rajesh Jha

(rajesh@array.ca).

5. ASL Environmental Sciences Inc. - Semi-Automated Classification of Oil slicks at sea using Radar and Optical imagery (SACORO)

Canada has been operationally monitoring its marine coastal areas for oil pollution using RADARSAT-1 data since 2006. The SACORO project will investigate the improvements that the more technically advanced RADARSAT-2 can bring to ISTOP, especially when linked to optical Earth Observation imagery to reduce false positives caused by marine algae. ASL Environmental Sciences Inc., from Victoria (BC), with partners MacDonald Dettwiler Associates and C-CORE, and in cooperation with the Canadian Ice Center, of Environment Canada, will develop new interpretive products using RADARSAT-2 and optical data for classification of oil slicks at sea. The project will use archived multi-polarization RADARSAT-2, RADARSAT-1 and optical satellite data acquired over oil slicks worldwide, especially the Gulf of Mexico oil spill. Using up-to-date machine vision techniques, we will automate the procedures to reduce manpower requirements and speed up the detection of oil slicks at sea. SACORO is expected to: (1) Validate RADARSAT-2 data for oil slick detection as a function of wind speed and incidence angle; (2) Develop a method of characterizing oil slicks based on viscosity derived from SAR polarimetry; (3) Investigate a method to identify and flag potential SAR derived false oil positives caused by algae and phytoplankton using optical satellite information; (4) Implement oil slick characterization from optical sensors as an input to the multivariate feature classification; (5) Refine the identification of false oil positives using features extracted from SAR, including slick morphology, contrast, viscosity (from 2) with a multivariate feature classification algorithm. The end product of SACORO will be a demonstration of semi-automated detection and classification of oil slicks that could be implemented as part of ISTOP. For more information, please contact Lyse.Champagne@asc.csa.gc.ca or tmudge@aslenv.com.

6. A.U.G. Signals Ltd.: New Change Detection Tools For Agriculture and Military Derived From RADARSAT-2

Through the CSA EOADP, A.U.G. Signals (Toronto, ON) is developing a project titled "Polarimetric coherent and covariance equalization change detection". The objective of the project is to increase the utilization of RADARSAT-2 data amongst government end users by way of developing a change detection tool specifically designed for military and agricultural applications. This project will be conducted in close collaboration with Agriculture and Agri-Food Canada and Department of National Defence. The main technical objectives of the project are to achieve (1) Automatic Covariance Equalization (CE) change detection capability and reduced false alarm; (2) Enhanced and optimized polarimetric InSAR coherence for Coherent Change Detection (CCD); (3) More comprehensive and enhanced change detection by using combined/fused CE and CCD. In terms of agricultural applications, the resulting capabilities could not only be applied to the boundaries/acreages changes, but also have the potential to detect differences in crop type and crop conditions. In military applications, the technology will enhance the ability to monitor enemy resources or activities during reconnaissance, detecting suspicious activity during surveillance, providing scouting ability for a moving convoy, and supporting situational awareness when protecting garrisons or high-value targets. For more information, please contact Lyse.Champagne@asc.csa.gc.ca and tliu@augsignals.com.

7. C-CORE: RADARSAT-2 Applications for Sovereignty and the Canadian Arctic

The importance of the Arctic and Canada's interests in the North has never been greater. Through the CSA EOADP, C-CORE (St. John, NL) is developing a project titled "Satellite Applications for Sovereignty and Environment of the North (SASEN)". This project involves satellite-based monitoring of critical regions of Canada's North. It addresses the Defence, Port Security and Marine Surveillance application domains and involves the Department of Defence North Warning System Office, PWGSC Real Property Branch, Department of National Defence (DND) Project Polar Epsilon and the Canadian Ice Service (CIS). The objective of SASEN is to develop products and deliver services using RADARSAT-2 that address a series of needs identified by the DND and CIS to monitor Canada's North for construction activity, hazard monitoring, infrastructure intrusion and maritime surveillance. The user needs addressed by SASEN will include: (1) monitoring decommissioned Distant Early Warning (DEW) line sites for 25 years; (2) more effective monitoring of ingress and egress at the North Warning System DND sites; (3) monitoring of coastal approaches for vessel detection and discrimination against icebergs, sea-ice and other false alarms; and (4) detecting critical infrastructure at risk. For this project, three North Warning System sites have been identified for monitoring. Once the project has been completed, the algorithms and analysis approach will be ready for implementation within DND operations. For more information, please contact Lyse.Champagne@asc.csa.gc.ca, peter.mcguire@c-core.ca.

8. Hatfield Consultants: Operational Monitoring of Fish Habitat in the Alberta Oil-Sands Region With RADARSAT-2

The Alberta oil sands are a significant component of the world's petroleum resources, with approximately 13% of the world's known reserves of crude oil. An estimated $123 billion in tax revenue is predicted from Alberta's oil-sands activities from 2000 to 2020. A key area of concern regarding oil-sands expansion is the potential negative effect of industrial water withdrawals on aquatic ecosystems of the Athabasca River and downstream Peace-Athabasca delta. Through the CSA EOADP, Hatfield Consultants (Vancouver, BC) is developing a project titled "Using RADARSAT-2 Data for Operational Monitoring of Fish Habitat and Instream Flow Needs in the Alberta Oil-Sands Region". Hatfield will demonstrate the use of RADARSAT-2 Ultra-fine beam, SpotLight beam, and Quad-Pol, Fine-beam imagery in the assessment and monitoring of Instream Flow Needs (IFN) for fish habitat in the lower Athabasca River watershed. This project will be conducted in close collaboration with Fisheries and Oceans Canada (DFO) and Alberta Environment (AENV). Parks Canada, who are responsible for the management and monitoring of the Peace-Athabasca delta in Wood Buffalo National Park (a UNESCO World Heritage Site), will also be a federal end user. For more information, please contact Lyse.Champagne@asc.csa.gc.ca and mdavies@hatfieldgroup.com.

9. MDA Geospatial Services Inc.: Operational Ice Mapping with RADARSAT-2

The Canadian Ice Center (CIS) mission is to provide the most accurate and timely information about ice in Canada's navigable waters. It is anticipated that RADARSAT-2 dual polarized ScanSAR imagery can provide increased input to ice classification and ice product development. Through the CSA EOADP, MDA Geospatial (Richmond, BC) is developing a project titled "Exploitation of Advanced RADARSAT-2 Capabilities for Operational Ice Mapping for the

Canadian Ice Center". MDA intends to work collaboratively with the Canadian Ice Service (CIS) to create tools and demonstrate products to aid in the operational mandate of the CIS. The main objectives are to (1) Increase the efficiency and effectiveness of the CIS in their increased use of RADARSAT-2 data for ice mapping and monitoring; (2) Develop innovative solutions, based on previous R&D and tool developments and where necessary new tools and algorithms, to solve specific problems identified by CIS; (3) Develop and demonstrate methods to enable the operational exploitation of these solutions into the current CIS work flow thus increasing adoption and utilization of the Canadian Government RADARSAT-2 data allocation. Expected results of this work: a prototype set of tools, visualization keys, and ice products that can be readily integrated in the near-term into CIS operations. For more information, please contact Lyse.Champagne@asc-csa.gc.ca and Gordon Staples (gstaples@mdacorporation.com).

10. MDA Systems Ltd.: New Change Detection Techniques for Canada and Afghanistan With RADARSAT-2

Strong, modern, world-class public infrastructures are a key factor in achieving the Government of Canada's priorities of a stronger economy, a cleaner environment and more prosperous and safer communities. The urban infrastructure aging stability and durability problem targets two issues: aging transportation structures and aging underground pipelines. It is very expensive and time consuming to map and monitor each infrastructure using surface and in-situ techniques. Through the CSA EOADP, MDA Systems (Richmond, BC) is developing a project titled "Application of RADARSAT-2 Amplitude, Polarimetric and Interferometric". The main objective of this project is to tailor and demonstrate polarimetric and interferometric change detection tools, where this technology can offer new and improved information. Specific application demonstrations are planned for: (1) National Research Council (NRC), by mapping surface movement and correlating this with risk of damage to urban infrastructure (Regina, Calgary and Montreal); (2) Canadian International Development Agency (CIDA), by demonstrating improved agriculture and better water flow resulting from CIDA funded renovation of the Dahla Dam and irrigation system in Afghanistan. With PS-InSAR derived risk maps, NRC is expected to be able to recommend better protocols for stability and durability of Canada's aging bridge and underground pipe infrastructure. Polarimetric Change Detection maps delineating surface cover improvement will help CIDA demonstrate the positive value of Canada's investment in renovating Afghanistan's irrigation system to improve water distribution. For more information, please contact Guy.Aube@asc-csa.gc.ca, jbusler@mdacorporation.com and Corey.Froese@ercb.ca.

10. Noetix Research Inc.: Sea Ice Applications and Training with RADARSAT-2

RADARSAT-2 is ideally suited for sea ice monitoring and mapping because of its ability to image through clouds, in the dark that has a long duration in the Polar Regions, very high frequency coverage in northern latitudes, and its ability to differentiate the ice types of most importance to users. The use of RADARSAT SAR imagery has had limited uptake within several Federal Government Departments for sea ice applications because (1) there has been a cost associated with ordering the data in the past, (2) the awareness of its availability is unknown, or (3) the knowledge to interpret the imagery is not present within the department. The adoption of RADARSAT-2 is particularly acute because its advanced imaging capabilities are new and complex to apply properly to maximize the information content. Through the CSA EOADP, Noetix

Research (Ottawa, ON) will demonstrate the use of RADARSAT-2 for a range of applications coupled with a strategy to integrate and sustain its use within key Federal Government departments including: Department of National Defence, Polar Continental Shelf Program (PCSP, NRCan), Parks Canada and the Department of Fisheries and Oceans. The integration of RADARSAT-2 into their operations will be achieved through three high level work elements: (1) Modify or develop products specific to the user requirements; (2) Demonstration of the products and access methods; (3) Training of users. For more information, please contact, Lyse.Champagne@asc-csa.gc.ca and john.bennett@noetix.on.ca.

11. PCI Geomatics Inc. - Monitoring of Ecological Integrity with RADARSAT-2

Ecological integrity and environmental protection are essential to Canada's future. Through the CSA EOADP, PCI Geomatics Inc. (Gatineau, QC) will provide a next generation of software capabilities, leveraging recent advances in high-speed computing hardware for automating synthetic aperture radar satellite (including RADARSAT-2) image correction, storage, and information extraction in an ESRI ArcGIS-compatible format. The proposed project includes improvements in the calibration, correction and accuracies, and quality of the output products. PCI is working in conjunction with Parks Canada (PC) , Environment Canada and the Canada Centre for Remote Sensing. The objectives of the project are: (1) to assist PC in meeting its Ecological Integrity initiatives as mandated under the New Parks Act (2002); (2) to develop advanced and innovative methodologies, systems, and products for PC and EC to increase their utilization of RADARSAT-2 data in order to transition its usage into GoC operations. PC and EC have identified the following high-priority products for development: Digital elevation models, automated orthorectification, water extents, polarimetric decompositions, ice on/off, and glacier parameters. CCRS will provide RADARSAT-2 expertise and scientific guidance to both PC and EC over the course of the project. PC personnel will be trained to maintain and use the system. For more information, please contact Lyse.Champagne@asc-csa.gc.ca and jones@pcigeomatics.com.

12. VIASAT GeoTechnologie Inc.: New mapping of Canada's North using RADARSAT-2

Natural Resource Canada's (NRCan) Centre for Topographic Information - Sherbrooke (CTI-S) is responsible for the acquisition, management and exploitation of digital topographic information to promote Canada's sustainable use of natural resources, environmental protection and economic development. As part of CSA's EOADP, VIASAT GeoTechnologies (Montreal, QC) has teamed up with Parks Canada (PC) and the Centre for Topographic Information - Sherbrooke (CTI-S, NRCan) to carry out a project titled "CartoSAR-Nord." The project is aimed at developing a methodological approach to using RADARSAT-2 data to produce information on the North above the 81st parallel that would be useful to the participating organizations. The project involves two principal activities: (1) experimental acquisition of topographic map data for an area of 40,000 km2 (38 sheets at the 1:50,000 scale), and (2) the extraction of useful information to monitor the ecological integrity of Canada's northern parks, mainly with regard to changes in wildlife habitat and landscape resulting from ground instability and hydrological change. To do so, primarily stereoscopic synthetic aperture radar (SAR) data and polarimetric data from RADARSAT-2 will be used. For more information, please send an email to Lyse.Champagne@asc-csa.gc.ca and mbenoit@viasat-geo.com.

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